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Adoption of cryptocurrencies and their need for network effects.

What is stopping cryptocurrencies from being widely adopted?

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Bitcoin is a technological tour de force.

Bill Gates

Bitcoin is worse than tulip bulbs

Jamie Dimon, CEO of JP Morgan

Instead of putting the taxi driver out of a job, blockchain puts Uber out of a job and lets the taxi drivers work with the customer directly.

Vitalik Buterin, co-founder of Ethereum

It's money 2.0, a huge, huge, *huge* deal.

Chamath Palihapitiya, former Facebook executive

One of my favorite words is a French word: sousveillance. It is the opposite of surveillance. Surveillance means to look from above; sousveillance means to look from below.

Andrea Antonopoulos

Table of contents

Introduction

A cryptocurrency is a digital or virtual asset designed to work as a medium of exchange that is based on three main technological pillars: cryptography, blockchain, and consensus algorithms to secure its transactions, to control the creation of additional units, and to verify the transfer of assets. Bitcoin is very close to “digital cash”. It functions pretty much in the same way. The holder of a bitcoin also has possession of it, and you can exchange it between users (this is allowed by the asymmetric cryptography keys). The value of bitcoin is not tied to any commodity or Fiat currency and is established almost completely by its users. Most like precious metal, the value of bitcoins stems from its scarcity and select use cases. Cryptocurrencies at their core are a by-product of blockchain technologies. At their most basic level, they function as an economic incentive to make the decentralized network work. They were thought to be a necessity in any “trustless” (we will come back to this) blockchain. How else are you going to motivate your users to “mine”, securing the network in the meanwhile? It was believed that nobody would ever use a network without the opportunity of some monetary gain. The question that Satoshi Nakamoto (the pseudonym for the person or group who invented Bitcoin) was able to answer through Bitcoin (while pioneering cryptocurrencies in general) was: “is it possible to move value from point A to point B, without the need of a centralized authority, in a trustless environment?”. Of course, we now know the answer to be yes. It is indeed possible.

With this thesis, I aim to develop a framework to examine and report on the various factors that are or will prevent crypto from being more widely used and adopted. I present four case applications of the framework with different country contexts and different stakeholder roles.

There are many different angles to be considered when talking about cryptocurrencies, and even more about how technologies are adopted in general. And even if we cannot predict the future, we can learn from the past to make sure that we are always ahead of the curve.

The following chapters will be developed as follows:

- *Chapter 1*: *Taxonomy of Bitcoin*. Focussing on Bitcoin, I provided a detailed account of the genesis and evolution of crypto, as to highlight its values and uses, as well as its risks and other factors that inhibit its adoption. I do this to demonstrate that despite its allure and success, this technology had yet to become a dominant global technology because of trust issues.

- *Chapter 2*: *The Framework.* I identify the frameworks and factors that influence technology adoption, and I apply them to cryptocurrencies.

- *Chapter 3*: *Use cases.* I apply the framework and factors identified and developed from *Chapter 2* to various use cases and I then summarize the findings.

Chapter 1 - Taxonomy of Bitcoin

In this chapter I provide an exhaustive introduction on cryptocurrencies. I do this to provide the background needed to understand the capabilities and flaws of the technology, to better be able to understand what drives and inhibits its adoption. I will use Bitcoin as a practical example to delve deeper into the development and use of cryptocurrencies.

In practice, by many, cryptocurrencies are seen as a new "payment system". It is right there in their name: crypto-*currency*. It must be possible to pay for stuff with this, and indeed it is. Many turned to Bitcoin almost immediately as soon as they understood its capabilities. A secure, persistent (censorship and block resistant), and almost untraceable system through which you can send money to anyone. Even better, it guarantees your pseudonymity. On the blockchain, you are as anonymous as you want to be. Right now, cryptocurrencies are being used mostly for speculation[1], but many small communities around the globe, especially in underdeveloped countries, found them to be the solution to many of their problems: from having access to a financial system in unbanked or underbanked countries[2], to having a way to combat inflation and capital controls of their state FIAT currency[3], and even to lower the costs of remittances or finally finding financial privacy for oppressed groups[4].

Bitcoin was the first completely decentralized cryptocurrency, or digital-currency. It is an open source, peer-to-peer payment system. Until its creation in 2009[5] by Satoshi Nakamoto (a pseudonym), moving value from A to B always required a third-party intermediary. This is because without this trusted centralized authority, responsible for keeping a ledger of all the transactions, digital money could be spent twice. This is known as the "double spending" problem. Even if Bitcoin was the first completely decentralized cryptocurrency, it definitely was not the first attempt at creating a "digital currency". Many have been toying with the idea since

[1] [14] Baur, D. G., Hong, K., & Lee, A. D. (2018). Bitcoin: Medium of exchange or speculative assets? p.15
[2] [66] City, C. O. in L. and S. P. in M. (2021, June 9). El Salvador Becomes First Country to Approve Bitcoin as Legal Tender. Wall Street Journal.
[3] [29] Edward-Ekpu, U. (n.d.). Nigeria is now the No.2 bitcoin market on this fast-growing global marketplace. Quartz. Retrieved May 24, 2022,
[4] [25] CBN obtains order to freeze #EndSARS promoters' accounts till January. (2020, November 6). Punch Newspapers.
[5] [88] Nakamoto, S. (2009.). Bitcoin: A Peer-to-Peer Electronic Cash System

the 1980s[6,7]. An American cryptographer (David Chaum) was the first to describe an anonymous digital payment system. Digicash was his attempt at putting in practice the protocol he described, but ultimately failed to jump start the network for various reasons. Flooz.com was a different kind of attempt on virtual money. It was part of a marketing campaign, and you would receive Flooz (worth 1$ each) for purchases made on their website, which you could then spend to buy other products on any of the online stores that participated in the project. The company closed up, as adoption by merchants and customers proved limited, and as it could never establish itself as a widely recognized medium of exchange. Also, as much as 19% of purchases of Flooz were fraudulent, part of a money laundering scheme in which stolen credit cards were used to purchase currency and then redeemed. Bit Gold was created in 1998 by Nick Szabo, a computer scientist and cryptographer who pioneered through its protocol the Proof of Work consensus algorithm. Bit Gold was never implemented, but has been called a direct precursor to the Bitcoin architecture. In the same year, B-money made its appearance. Created by a Washington graduate student, Wei Dai, B-money was directly referenced by Satoshi Nakamoto. This project as well was never developed further than the initial divulgation of its white paper.

Bitcoin's decentralized p2p network, made up of hundreds of nodes, takes the place of the itnermediary. A can move value to B without having to go through any of the usual circuits (Visa, Mastercard, Paypal, etc…). The value of bitcoins is also determined by simple demand and supply mechanisms, and is not tied to a commodity or other fiat currency. Its value is what people assign to it.

The Bitcoin system is based on three technological pillars: cryptography, the blockchain, and the consensus algorithms. The transactions, in particular, are secured through the use of public-key cryptography. Each user can generate two *keys*, a private one that is to be kept a secret, like a password, which allows you to spend the bitcoins you own, and a public one, which is usually referred to as your "Bitcoin address", which allows others around the network to send you bitcoins. Every transaction is recorded, time-stamped, and then appended in the latest *block* of the blockchain. The continuity between the blocks of the blockchain is guaranteed

[6] [3] Costello, A. (2020, February 21). The history of first cryptocurrencies before Bitcoin. All about Cloud Bitcoin Mining—Hashmart Blog.
[7] [4] Five Dot-Coms That Didn't Survive The Bubble. (2010, January 25). TechnoBuffalo.

through another cryptographic primitive: hashing functions. The Bitcoin blockchain network depends on its miners to function: users that contribute their machines computing power to the network to validate and confirm transactions. Thousands of scattered processors, ranging from single computers to entire server farms solve complex mathematical problems to verify the transactions. These users are then rewarded for their work with newly minted bitcoins (as well as the transaction fees gathered from the network). Miners are what interacts with the last technological pillar of Bitcoin: the consensus algorithm[8]. A consensus algorithm is a set of rules used to determine how a distributed network of computers reaches agreement about the state of a shared database. In a blockchain context, the consensus algorithm is used to verify and validate new blocks of transaction data before they are added to the blockchain. Bitcoin utilizes "Proof of Work[9]" as its consensus algorithm, which consists in finding a sequence of data that produces a particular pattern in its hashed output. When a match is found, the miner that found it is rewarded through the "coinbase transaction", or the first transaction of the new block, which assigns to the miner its bounty. The Bitcoin algorithm is so that the size of this "bounty" is reduced, as more and more bitcoins are mined. The difficulty of the Proof of Work algorithm is also dynamically adjusted so that it remains proportionate with the total hashing power of the network, ensuring that bitcoins are minted at a predictable rate. These two peculiarities make it so that bitcoin mining mimics the production rate of a commodity such as gold, finding less and less of it, for a higher (computational) cost as the mining effort increases. At some point, there will be no more bitcoins to mine, and only the network's transactions fees will remain as economic incentive.

Bitcoin has some very valuable properties: it is a pseudonymous blockchain[10]. This means that your identity is not (directly) tied to your wallet unless you want to. You can be as anonymous as you want to be in the Bitcoin blockchain, but it is not as alarming as the media seem to claim. Unlike a cash transaction in fact, which is completely anonymous and untraceable, every transaction ever occurred on the Bitcoin blockchain has been recorded, along with the public keys that participated in these transactions. And they are all publicly viewable in the blockchain. Also, tying

[8] [2] Consensus mechanisms. (n.d.). Ethereum.Org. Retrieved March 4, 2022
[9] [6] Proof-of-stake (PoW). Ethereum.Org. Retrieved March 4, 2022
[10] [5] Hertig, A. (2022, January 24). Bitcoin Isn't Private

your “real world” identity to a Bitcoin address is not as difficult as it may seem. Going through any of the centralized exchanges today means having to go through some KYC procedures which inevitably tie your identity to some bitcoins at least. To truly be completely anonymous one would have to use many precautions, from using a different internet access than your home one, to using the TOR browser and Tails OS to cover your tracks. And you would still have to be careful to never transact with any wallet that may be tied back to you. In reality, staying anonymous in the Bitcoin network is very ambitious, also because, given the persistence of the blockchain, your identity may be tied to a transaction *years* after it was made, and in the recent past, there have been many cases of fraud and market manipulation that have been discovered thanks to the transparency of the network, as well as the users which take it upon themselves to personally “audit” a centralized exchange or an individual’s wallet[11].

Bitcoin transactions not only have drastically low fees per transaction, but are also quicker and more available (round-the-clock possibility to transact) than traditional payment methods (wire). The combination of these three things, as well as the properties of the underlying technology, makes it so Bitcoin is able to protect individuals against censorship and capital controls, and has been effectively used to improve access to capital in unbanked states, and ensure the financial privacy of oppressed groups.

But all that glitters is not bitcoins, and there are many problems which have yet to be addressed. The technologies at play (blockchain especially) are still new and immature and the market is currently trying to push them onto any possible application. Even without mentioning the many conflicts of interest (rug pulls), self-serving hype (pump and dump schemes), and obfuscation of information that surrounds every new Dapp project, ICOs, etc… one can recognize that the cryptocurrency market, right now, is euphoric and unpredictable. Very few truly understand what is going on.

Another evident risk of cryptocurrencies is their volatility. While many have seen crypto as an investment opportunity to further differentiate their portfolio, there is no way yet to tell the correlation between the market and bitcoin’s price, nor are we

[11] Reddit - Coinbase insider trading

able to say with certainty that the value of bitcoin will keep increasing/remain stable. One if not the only certain thing right now with cryptocurrencies is that they are volatile. Movements of 10-20% in a matter of hours are not only normal but almost expected at this point. It may not be a problem for those users that purchase bitcoins just to transact (as they will not care for what value it might have tomorrow), but it remains one of the main issues for all of those that need bitcoin as a store of value.

[Fig. 1] Bitcoin Volatility from TradingView

Although in recent years the volatility of bitcoin seems to have been decreasing (Fig. 1), it is far from being at an acceptable level for any user other than those speculating on its wild movements.

Security is also an implicit problem of Bitcoin. The “trustless” property of the Bitcoin network (and of cryptos in general) is very often misunderstood. It is true that no trust is required between you and any other participant in the network, but you are still trusting the “code” to be free of bugs and devoid of any errors. You are trusting the developers working on the underlying technology to understand what they are doing, and trusting the independent auditors (or good samaritans) that double check their work. How many can say that for themselves? This security problem is further uncovered when one realizes that Bitcoin’s *protocol* is theoretically unhackable, but all the other softwares orbiting around it (from wallets to DeFi applications) are more than vulnerable to malwares, hacks, and the likes. The software storing your private and public keys can be hacked and compromised to the same extent that a traditional

bank account could. Not only individuals, but also exchanges have many times failed to provide an adequate level of security for its users, and millions of dollars have been lost in the meantime.

There are also reasons for governments and states to be concerned with some of Bitcoin's uses. Thanks to its pseudonymity, Bitcoin can allow criminals to accept payment for illicit goods and services, as well as facilitating money laundering. A great example of this would be the now defunct TOR website "Silk Road". This market, powered by Bitcoin, allowed its users to access a vast online black market, where one could order drugs, as well as forged identity documents and more peculiar things. The money laundering problem has long been discussed but so far has remained as a more theoretical problem. Mainly because the transactions needed for the money laundering process, because of the persistence of the blockchain, will always remain public and accessible at any time, even to law enforcement. Also, many centralized exchanges have started to comply with AML requirements (as well as the KYC mentioned earlier), making it ever more difficult to move money in and out of the network without traces.

Currently, yet another risk of cryptocurrencies is their tendency toward centralization[12]. Miners or stakers of the crypto's blockchains are rewarded for their effort in validating transactions through block rewards and fees. Unfortunately, this system seems to make the system as a whole converge toward a centralized state, most likely because of the economies of scale they provoke. Since mining pools and mining in general assign rewards based on the percentage of hash rate you own on the pool, and given the high cost of entry for new miners (ASICs or mining rigs, servers, electricity, etc…), this system instigated the proliferation of mining as a business. All those that managed to start a fairly big mining farm are also those that can get better deals on electricity, on mass purchases of machinery and electronics, etc… This, of course, to the detriment of the network. The divide between the miners and the users of crypto is important. Ideally, every user should be a participant in the network, not only in their use of it (transacting) but also in doing their part as validators of the network. This is not true for most of those cryptocurrencies whose network is

[12] [8] Senatus. (2021, July 2). Why 99% of cryptocurrencies centralize over time (and how it might affect your investment). Medium.

powered by these economic incentives. Some, like Monero[13], try to reduce the economies of scale incentivized by these systems by making the PoW unfeasible through ASICs (integrated circuits that are specifically designed to perform a certain set of tasks), favoring the use of CPUs which are more widely available to the general public. But the reality is that this kind of consensus algorithm will always create a "business" behind the mining.

Of course, cryptocurrencies are evolving in a variety of ways. Some are becoming more user-friendly, while others are adding new features or increasing their security. Some like Monero and ZCash developed to allow for 100% anonymity of their users, having an "opaque" blockchain, which is transparent but makes it virtually impossible to retrieve the data of any given transaction that ever happened (thanks to some novel cryptographic methods for zero-knowledge proofs and ring signatures). Some, like the stablecoins have been developed to combat the volatility of cryptocurrencies. Some, like Ethereum, were developed with a completely different directive in mind, and are today the basis for decentralized applications, NFTs, and more. These all differ in one or more ways from Bitcoin, but I believe that the main idea behind any cryptocurrency is well represented by Bitcoin, which as of today (20/05/2022) still has the highest market cap of any crypto, being twice that of its second competitor (Ethereum) and almost seven times that of its third closest competitor (Tether)[14].

[13] Monero resources
[14] Data from CoinMarketCap (20/05/2022)

Chapter 2 - The Framework

While Bitcoin is yet to be widely accepted, it has the potential to revolutionize the way we think about money. Then why is such a revolutionary technology not being used on a large scale? In this chapter, I review who are the main stakeholders at play, as well as some of the existing research on technology adoption and innovation diffusion frameworks, and propose a model to better explain why Bitcoin is different.

There are a number of stakeholders in the cryptocurrency environment, each with different interests, incentives, and abilities to influence the future of crypto. They may be grouped into three main categories: governments, banks, and citizens.

First of all, **governments**. Governments have few primary directives when it comes to currencies. They strive for financial stability, market integrity, and enlarging their tax base. Of course, any government needs economic stability to be able to function. Financial stability may be intended as the stability of the overall economy and their Fiat currency. This can also be a mirror of the stability of the banking systems. Market integrity is the promotion of trust and confidence in the market, by ensuring that there are as few frauds, manipulations, and malevolent behavior as possible. This can be also intended as the amount of transparency present in a system. The more transparent it is, the more you can reduce fraud and manipulations, thus increasing integrity and allowing you, the investing public, to have more confidence in the market. Taxes are the final point we will touch on. Of course, every government always aims to increase and include everything in their tax base. This includes "digital assets" such as cryptocurrencies. Since cryptocurrencies seem to be here to stay, many states have already moved forward in many ways, from simply acknowledging their existence, to outright banning them, even upholding them as legal tender[15].

Second, **banks** have another important role in this. Of course, finance has been a sector particularly touched by the emergency of cryptocurrencies. Especially when they also transformed and deviated from their intended purpose as "digital currencies" and evolved into a new asset type, the first one since derivatives were introduced in the 1970s. Now, through ICOs (Initial Coin Offerings), cryptocurrencies

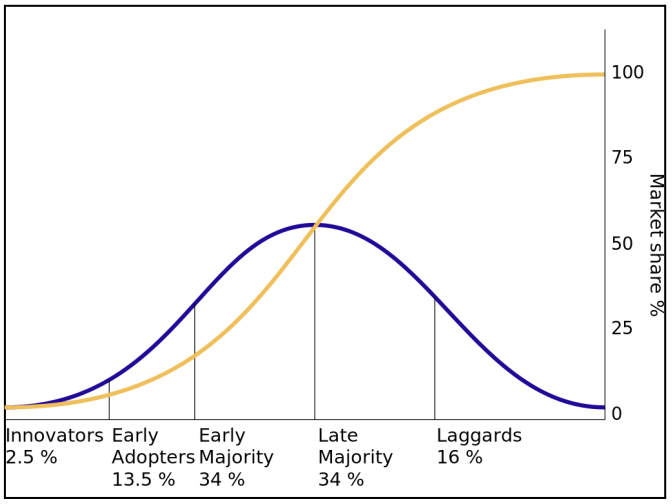
[15] Legality of Cryptocurrencies by country or territory, Wikipedia

are being used to gather funding used to develop decentralized applications and other initiatives, essentially for free. The sellers of these tokens have no legal duties toward the buyers. It may even be considered a form of crowdfunding. But it is undeniable that at least for now, these are also entangled with get-rich-quick schemes and speculation. CBDC or Central Bank Digital Currency also have created a lot of debate. The main arguments for central banks issuing digital currencies are that it could help to increase financial inclusion and reduce costs associated with our "traditional" (or *legacy*) banking infrastructure. The main argument against this is that it could lead to inflationary pressures and increase the risk of financial instability, which would go against the will of any state. There is also the simple problem that in theory, the ability to "make" a currency has always been reserved for governments or states. Fiat currencies are backed by governmental authorities and there is good reason for this, as currency is the primary source of revenue for any state or government, through taxation.

Third, we come to the **citizens** or **non-institutional users** of cryptocurrencies. In the short term, they can provide a more efficient and cost-effective way to send and receive payments. But much like hard cash, they can also offer a degree of anonymity and privacy that may be beneficial for some users. Finally, they also have a high level of security (decentralization) and protection (resistant to censorship), also allowed by the transparency of the blockchain, against fraud and theft. This is important, especially in finance, in which information asymmetries are usually exploited for gains by brokers, insider traders, etc... All of this, at least for now, at the cost of the increased risk of losing all of your assets if you lose the private key to your wallet.

The adoption of technology has been studied extensively in the past. One of the most famous theories is the innovation diffusion theory[16], by Everett Rogers, which pioneered it first in 1962. Rogers argues that diffusion is the process by which an innovation is spread over time among a population in a social system. In particular he defines a critical moment in which the innovation becomes "self-sustaining". At a certain point in the diffusion process, the rate of adoption increases suddenly, creating the typical S-curve of diffusion[17] (Fig.2).

This was the principle through which it is believed that the STOP AIDS campaign work, suggesting that only the early adopters (which are few) are required to initiate a new behavior for it to spread through the population[18].



[Fig. 2] Source: Rogers Everett - Based on Rogers, E. (1962) Diffusion of innovations.

Diffusion research also considers time as an important variable of the equation. Ryan and Gross (1943) were surprised to discover that the diffusion of hybrid corn (an innovation in the farming industry, increasing the yield of corn field by about 20% per acre) required 12 *years* to reach widespread diffusion. By contrast, the adoption of tetracycline (a newly developed oral antibiotic) took only 17 months before widespread adoption was achieved. This might be because of the obvious differences between the medical and agricultural fields, the latter being a much slower field, tied to the lifecycle of the plants. But as Rogers & Kincaud (1981) found that interpersonal communication with peers is necessary for individuals to adopt a new

[16] [21] Rogers, E. M., Singhal, A., & Quinlan, M. M. (2019). Diffusion of Innovations
[17] [21] Rogers, E. M., Singhal, A., & Quinlan, M. M. (2019). Diffusion of Innovations, p. 427
[18] Wohlfeiler, 1998, p. 231

idea, also Coleman et al. (1966) found that doctors linked in more interpersonal networks tended to adopt innovation more rapidly than isolated doctors. This makes sense also for the slower adoption of hybrid corn, combining the slow timeline of farming with the isolation usually present between farms, and the occasions to discuss the new innovation might have been few and far between for the farmers. But this makes the adoption of Bitcoin counterintuitive. Today, we are more connected than ever, and innovations are adopted faster than even: 40 years were required for the totality of households to have a refrigerator, 30 years for 90% to have a microwave oven, but only fifteen years for almost 90% to have a cell phone[19]. Then why is Bitcoin not spreading faster? The adoption of Bitcoin currently matches the *innovators* category in the S-curve, and have yet to reach the critical mass needed for its adoption to be self-sustaining[20].

Another important model for the adoption of new technologies was defined by Davis (1989). In his paper "Perceived usefulness, perceived ease of use, and user acceptance of information technology", he analyses several theories (such as the expectancy theoretic models, the self-efficacy theories, the cost-benefit paradigm) and then converges on his TAM model. The Technology Acceptance Model defined by him models user's acceptance of new technologies, and is based on two main ideas: perceived *usefulness* and perceived *ease of use*[21]. *Perceived usefulness* is defined as "the degree to which a person believes that using a particular system would enhance his or her job performance" and *perceived ease of use* as "the degree to which a person believes that using a particular system would be free of effort". Ease of learning a new technology is regarded as one substratum of the ease of use construct in Davis research[22], but I would argue that the resources and capabilities of learning a new subject or technology have an importance, and would consider them "facilitating conditions", or determinants of the ease of use of a technology, as was done for other parameters in the TAM3 model[23].

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[19] [16] Gonçalves, S., Laguna, M. F., & Iglesias, J. R. (2012). Why, when, and how fast innovations are adopted, p.2

[20] [20] Presthus, W., & O'Malley, N.O. (2017). Motivations and Barriers for End-User Adoption of Bitcoin as Digital Currency, p.95

[21] [15] Davis, F. D. (1989). Perceived Usefulness, Perceived Ease of Use, and User Acceptance of Information Technology, p. 320

[22] [15] Davis, F. D. (1989). Perceived Usefulness, Perceived Ease of Use, and User Acceptance of Information Technology, p. 325

[23] Venkatesh and Bala (2008)

Another factor which seems to be overlooked is how regulators (a state's government, central banks, etc.) can heavily influence the direction and rate of adoption of innovation.

Most of the studies done on technology adoption and diffusion are also self-reported, meaning that the respondents of the study are required to fill in a survey. The problems of these kinds of studies are voiced by Davis as well[24], who mentioned that "Not enough is currently known about how accurately self-reports reflect actual behavior". It would be interesting to see how this kind of research could be done today, given the huge amount of data a software company could be able to extract from their users (think mouse movement tracking, time spent between actions, ratio of GUI used v. keyboard shortcuts, even up to eye tracking technology to see where the attention is being spent by the user, or what kind of online resources he prefers to learn from).

Furthermore, specific to Bitcoin research, consider this: "We find no trace of network effect, or influence by others, when we asked why they became bitcoin users[25]". Is it not weird, considering Bitcoin is supposed to thrive on network effects? Instead, the main reasons found by the study are technological interest and curiosity[26]. This seems to be the general consensus in both academic and independent surveys on Bitcoin's adoption[27,28,29]. Most research seems to be falling for the same WEIRD bias[30]. In 2010, Henrich, Heine, and Norenzayan reported a bias in conducting psychology studies with participants from *WEIRD* (an acronym, meaning "Western, Educated, Industrialized, Rich, Democratic") societies, which are then generalized for the rest of the global population. In the same way, most citizens of such countries have no direct *need* for Bitcoin technologies, since they are used and invested in their

[24] [15] Davis, F. D. (1989). Perceived Usefulness, Perceived Ease of Use, and User Acceptance of Information Technology, p. 334
[25] [20] Presthus, W., & O'Malley, N. O. (2017). Motivations and Barriers for End-User Adoption of Bitcoin as Digital Currency, p. 94
[26] [20] Presthus, W., & O'Malley, N. O. (2017). Motivations and Barriers for End-User Adoption of Bitcoin as Digital Currency, p. 93
[27] [20] Presthus, W., & O'Malley, N. O. (2017). Motivations and Barriers for End-User Adoption of Bitcoin as Digital Currency, p.95
[28] [14] Baur, D. G., Hong, K., & Lee, A. D. (2018). Bitcoin: Medium of exchange or speculative assets?
[29] [23] Yoo, K., Bae, K., Park, E., & Yang, T. (2020). Understanding the diffusion and adoption of Bitcoin transaction services: The integrated approach
[30] [85] Henrich, J., Heine, S. J., & Norenzayan, A. (2010). The weirdest people in the world?

current financial and banking system which very much functions with a high degree of efficiency.

The conceptual model I propose (Fig. 3) is based on four variables: *Ease of use*, *need* (perceived, for the technology), *facilitating conditions*, *regulators perception* (of the technology). In a few words, it is a revision of the TAM model, with two simple additions.

Ease of use is very much the same as the one described by Davis, single-handedly it encompasses many important principles of how a technology is perceived to be usable "free of effort". How compatible the new technology is with the older systems, how complex it is, how easy it is to learn and be proficient in, and more. Poor reliability tends to always drive away users from technology use[31], and in the case of cryptocurrencies the less unreliable part of the system is on the user side. Software, web applications, which can be overly complex and not immediate even for the most advanced users. Very often users have a hard time learning because of bad design[32]. Things do not behave the way people expect or are hard to figure out on their own, and indeed cryptocurrencies, especially at the beginning, have a very steep learning curve. There are multiple concepts that you have to understand (at least on a practical level): from private/public key cryptography, to the fee economy behind the blockchain and how the various networks (BTC, BEP20, BEP2, ERC20, just to name a few) are used in each blockchain for what transaction. It can be overwhelming, especially for users that may already be on the fence about a technology that they do not understand. What is overall needed for a broad adoption of cryptocurrencies may simply be a higher level of education on the subject, and a simplification of the overall systems mechanisms. One of the biggest challenges to using cryptocurrencies is actually setting up a wallet and understanding how to obtain funds and sending/receiving them. Once a transaction is sent to the blockchain to be approved, if the address you inputted is wrong by a single digit, those funds will be lost, period. There is no central authority that will help you get them back, no support center to ask for direction. You are responsible for understanding, and correctly using the

[31] [106] L. Butler, Martin Sellborn (2002). Barriers to Adopting Technology, p.24
[32] [106] L. Butler, Martin Sellborn (2002). Barriers to Adopting Technology, p.25

technology. It's scary! And no amount of stress should be present when making a simple transaction to pay for groceries or while sending money to a friend.

Need (perceived) is mirrored from the concept of *perceived usability* described again by Davis, renamed to be more in line with the technology we are concentrating on (Bitcoin) and the variety of contexts in which it is being applied.

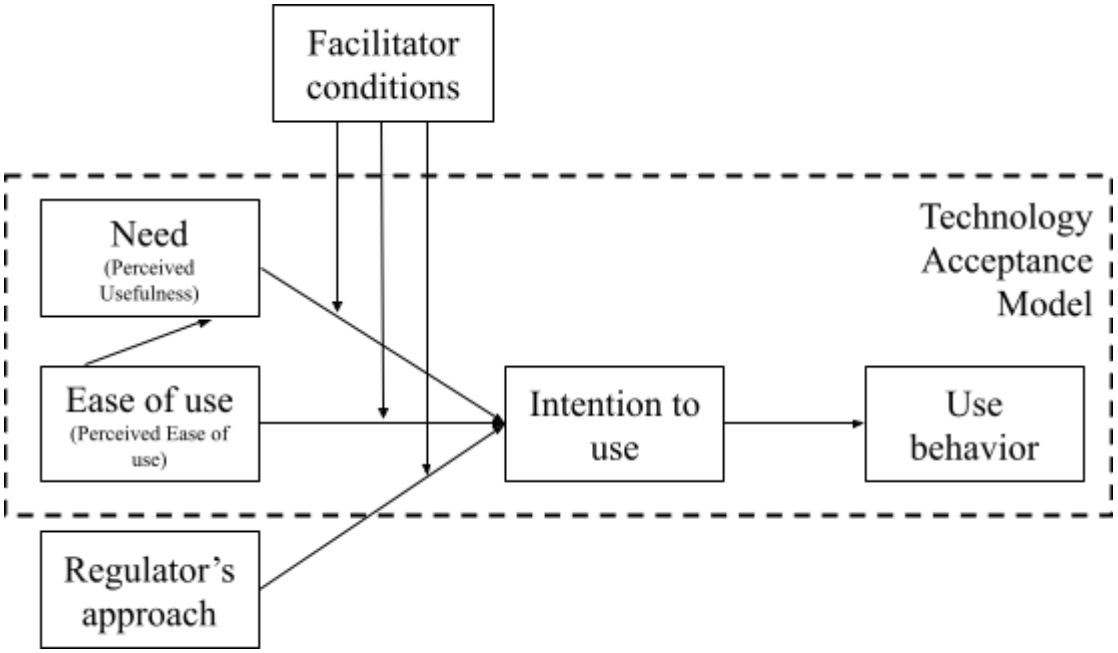
Regulators perception (of the technology) covers how and why regulators act on a technology. Able to regulate technology through laws and policies, they have the ability to support or suppress the development and adoption of new technologies. Bitcoin (or any crypto) is not easily fitted into our current laws[33]. Also, like any technology, cryptocurrencies are a tool that can be used for both good and bad. The regulations required to further boost the crypto's value will have to advance their benefits while minimizing its unwanted uses. Although the evidence of crypto's use mainly for illicit activities is mostly based on hearsay, the illicit use of cryptos should be tackled. Unfortunately, it is complicated to regulate such a technology without hindering its legitimate uses and developments. As there is no central authority to target, rendering cryptocurrencies illegal would only deny access to the system to law abiding citizens. The biggest regulatory opportunity in the cryptocurrency space are the exchanges. Requiring (as is happening) them to keep records and to report suspicious activity just like any other traditional bank will be fundamental. Bitcoin and cryptocurrencies in general should be integrated into the existing financial regulatory framework. In the future, there will also be a need to differentiate cryptocurrencies in a different category from traditional FIAT currencies, as there may be a need for different taxation, regulation, etc…

For the users, the most alarming point of using cryptocurrencies is definitely the lack of a line of responsibility which is normally present in our current systems. The blockchain, because of how the system is structured, has no way to litigate or dispute wrongful transactions. Some associated decentralized systems (such as Bisq) have implemented a necessary security deposit that creates a strong incentive for buyers and sellers to follow the rules of Bisq trading protocol ("If a trade is disputed through a mediator or arbitrator, some or all of the offending party's security deposit may be awarded to the counterparty. Examples of protocol violations include a buyer failing

[33] [104] Brito, J., & Castillo, A. (n.d.). Bitcoin: A Primer for Policymakers, p.67

to pay a seller, paying with a different account or with a different name, or a seller failing to acknowledge receipt of a buyer's payment"[34]). But we are still talking about a system which is unrelated to the blockchains in which cryptocurrencies operate. A method like this could still be implemented to further boost controls and reduce the risk of adoption by the general public.

Facilitating conditions[35], is what data analysts would consider a "catch all variable". It comprehends all other indirect factors which might affect the adoption of technology (Bitcoin) in specific cases. Some examples which will be brought up later are internet penetration, percentage of english-speaking population, etc.



[Fig. 3] Bitcoin Adoption Model

[34] [94] Bisq FAQ
[35] [18] Help University, Malaysia, & Lai, P. (2017), p.28

Chapter 3 - Use cases

In this chapter I review and analyze various cryptocurrencies use cases to be able to further understand what cultivated or constrained the adoption in these scenarios. Next, in the conclusions, I summarize my results and give recommendations to what can be done to further increase cryptocurrency adoption.
Each use case will be reviewed in the following way:

1. Background information on the case
2. Further analysis of the case's implications and possible developments
3. Debrief on how the framework applies and what we can learn

Nigeria and Bitcoin

Nigeria's economy is the largest in Africa. It is fairly diversified, with the agriculture, manufacturing, and oil sectors making up a large portion of the country's GDP[36]. However, the majority of Nigerians still live in poverty, and the country has been facing significant challenges in providing adequate infrastructure and services to its citizens. As of 2020, 55% of the total adult population was unbanked[37], and a large disparity in financial access remained present for some of Nigeria's most financially excluded groups.

The #EndSARS[38] is a still ongoing decentralized social movement calling for an end to the use of the Special Anti-Robbery Squad, a controversial Nigerian police unit accused of extrajudicial killings, torture, and extortion. The movement was coordinated mainly through social media and gained a lot of publicity on Twitter, where the protest took its name from a hashtag started in 2017. In 2020, the movement saw a rekindling after more revelation of the abuses of the unit, and subsequent mass demonstrations occurred throughout all the major cities of Nigeria.

This is where bitcoins came into play. The position of Nigeria on the legality of "virtual currency" (as it was called in the first Central Bank of Nigeria letter addressing the matter in 2017[39]), began with a *request* from the CBN that asked banks to "not use, hold, trade and/or transact in any way in virtual currencies". A general request to monitor their user's interaction with cryptocurrencies was also issued, to make sure that these individuals were not money launderers or terrorism financiers. No limitations were imposed on their citizens, which remained free to use crypto at their own risk. And use they did, especially when, during the 2020 protests, many protesters' bank accounts were freezed[40]. A particular case has been that of "The Feminist Coalition", which during the outbreaks of protests against the police, concentrated on providing healthcare, legal aid, and even funding to those participating in the demonstrations.

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[36] [35] Nigeria Economy. (n.d.). Retrieved May 24, 2022
[37] [38] Nigeria: New data from EFInA shows financial inclusion growth. GOV.UK
[38] From twitter to Nigeria Streets, Amnesty International
[39] [96] Aml january 2017 circular to fis on virtual currency
[40] [30] EXCLUSIVE: Court documents confirm CBN froze bank accounts of Rinu, Pamilerin, Gatefield, 17 other #EndSARS champions. (2020, November 6). People's Gazette.

[Fig. 4] Tweet from Jack Patric Dorsey, Twitter

Because of their connection with the #EndSARS protests, their accounts were freezed[41], and they turned to Bitcoin in order to raise donations, managing to accumulate roughly 3.14BTC (~36'282$) in just 2 days, after implementing the option of donating through crypto. The donation of bitcoins for the campaign were even endorsed by Jack Patrick Dorsey, co-founder and ex-CEO of Twitter, through a tweet of his own[42] (Fig. 4).

Nigerians were no strangers to how the Bitcoin network could improve upon their legacy financial systems. Many were already using Bitcoin to resist police extortion[43], where officers would often threaten and extort citizens for whatever money the could find. Peer to peer exchanges such as Paxful saw a 20% growth driven by Africa, in which cross-border payments are the most common use case[44]. Many of their users in Ghana are in fact Nigerian expatriates sending remittances home through Bitcoin. Given that Nigeria is also trying to limit the use of dollars exiting Nigeria by restricting foreign-currency access, many are also using Bitcoin to transact internationally[45]. The main complication in these kinds of trades for Nigerians is finding a way to exchange Naira for other currencies, given the low volume issued at the official exchange rate by the central bank (about $200 million each week[46]). They typically rely on the black market, but that comes at a very high price, with markups up to 60% the CBN defined rates[47]. Through bitcoins, all of the international

[41] [31] Harper, C. (2020, October 16). Nigerian Banks Shut Them Out, so These Activists Are Using Bitcoin to Battle Police Brutality.
[42] [39] Twitter CEO, Jack Dorsey, endorses #EndSARS, asks people to donate bitcoins. (2020, October 14). Tribune Online.
[43] [33] Hertig, A. (2020b, August 26). Unconfiscatable? Using Bitcoin to Resist Police Extortion in Nigeria.
[44] [26] Cuen, L. (2018, December 31). Bitcoin Exchange Paxful Sees 20% 2018 Growth, Driven by Africa.
[45] [32] Hertig, A. (2020a, August 13). Nigerians Are Using Bitcoin to Bypass Trade Hurdles With China.
[46] [24] Can you spare a dollar? The Economist. Retrieved May 28, 2022
[47] Nairatoday

banking routing processes can be bypassed, avoiding the many fees imposed by them. Many have also started to use Bitcoin as their store of value of choice, on account of the naira's inflation rate, which has been over 10%, peaking at just over 18%, in the past five years[48].

In 2021, the CBN issued a letter stating that dealing with bitcoins or any other cryptocurrency by banks became prohibited[49]. Any bank found to be breaching this directive would face severe regulatory sanctions, or in other words, a likely seizure of their license to operate. The letter stated that the new regulation had "immediate effect", leaving commercial banks with no time to sort their affairs.

Most of the cryptocurrency apps had to integrate with a Nigerian bank, as partners, to facilitate the exchange of cryptocurrencies between users, as well as to make it easier to move from the naira to BTC and vice-versa. This meant that many companies like Binance announced that they would no longer accept naira as a viable currency to fund the purchase of crypto. But this did not mean that the use of crypto has reduced. While less straightforward, peer-to-peer trades are still very possible and alternatives ways to get around the ban on the use of Naira to purchase cryptocurrencies, such as obtaining a USD domiciliary account in Nigeria, are being exploited. From 2016 to 2021, Nigeria had traded well over 60000 bitcoins through Paxful[50] (where Nigerians make up around a quarter of its customer base), for a total value of 566 millions of dollars. Some estimates show that the total volume of bitcoin traded in Nigeria averaged at around $200 million per month, which is more than what was traded on the Nigerian Stock Exchange in Q2'2020[51].

We can notice that the main value points of cryptocurrencies (resistance to censorship and blocks, decentralization, lower fees, and ease of transacting) are all being capitalized on by the Nigerians. Another important factor also emerges from this story: the need for cryptocurrencies to be integrated into our current legacy systems. It is important to realize that a major role in the fast adoption of crypto in Nigeria was the big (up to the ruling of 2021 banning commercial banks from dealing

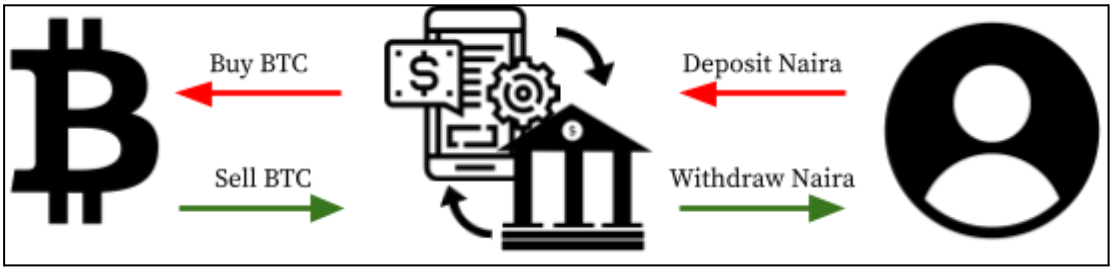
[48] [36] Nigeria Inflation Rate—April 2022 Data—1996-2021 Historical—May Forecast. (n.d.). Retrieved May 24, 2022

[49] [97] Letter on Crypto.pdf. (CBN)

[50] [29] Edward-Ekpu, U. Nigeria is now the No.2 bitcoin market on this fast-growing global marketplace. Quartz. Retrieved May 24, 2022

[51] [98] Cryptocurrency: How the CBN restriction cuts off exchanges. (2021, February 6)

with crypto[52]) integration that the many fintech startups had with local banks. One could simply connect their local bank account to these systems and start buying/selling bitcoin (Fig. 5).



[Fig. 5] Scheme of operation BTC - Users

This is crucial, because it means that at least during this transitional period in which FIAT and crypto currencies will have to coexist, they will both benefit from the latter being integrated into our current financial system. Mainly because the ban on the possibility to transact crypto through Naira not only did not prevent people from doing so through loopholes, black markets, and p2p transactions, but also removed altogether the opportunity for the CBN to be able to check on the crypto transactions and the movement of the Naira in and out of their economy through these channels. This again highlights the essential role of regulations in cryptocurrencies, which could be significant in allowing the technology to reach its full potential.

Then, if we look at this case from the framework point of view, cryptocurrencies fulfill a fundamental **need**, which is making financial systems available for the general public. Specifically, the needs may be multiple: the necessity for lower *fees* on remittances, the availability of a transportable *store of value* which is not cash that can be stolen from you. This increases the adoption and use of the technology. The subsequent ban on the technology added or reinforced the *need* for financial security of Nigerians.

The **ease of use** of the technology was significantly reduced in Nigeria, since Bitcoin was being integrated with their current banking system thanks to the main defi and startup applications focused on Bitcoin use, making it much easier for people to interact with the technology. We saw how the higher level of integration was boosting the use of crypto, and how the subsequent ban did not stop the citizens from continuing to use a technology they were already *proficient* in. A *critical mass* of

[52] [97] Letter on Crypto.pdf. (CBN)

users had also probably already been reached, and in the end it only further boosted the use of the technology, albeit it was required initially to bootstrap its adoption.

The **regulator's approach** to cryptocurrencies in Nigeria highlights the hindrance that they can pose to the adoption of technology. Had they acted faster they could have probably slowed the adoption of Bitcoin much more. The lower and lower trust in their government was already bringing many Nigerians into adopting Bitcoin[53], and the facility of use granted by the integration of Bitcoin into their banking system, thanks to the absence of a clear response by the authorities to how banks should approach crypto allowed for a faster diffusion of the technology. The subsequent ban on dealing with bitcoins or any other cryptocurrency by banks had many services shut down temporarily and/or registered a hit in trades[54]. But the ban did not hinder the use of the technology at all, it only shifted its use to less secure platforms and workarounds, reducing even more the control the authorities had on the matter.

The main **facilitating conditions** Nigeria has is that it is an english speaking country, which makes available for use and learning a much higher amount of knowledge and resources, which may have eased the learning curve and boosted the usability of cryptocurrencies. The main impediment instead could be internet penetration, which was around 50% in January 2020[55], meaning that more than the other half of the population does not have access to the internet, and therefore, cryptocurrencies. The low internet penetration could also imply that the parts of the population less exposed to digital technology would have lower levels of digital literacy, making the use of cryptocurrencies even more complex for them.

[53] [100] Thriving Under Pressure: Why Crypto Is Booming in Nigeria Despite the Banking Ban. (Coindesk)
[54] [99] Nigeria's SEC says central bank's crypto ban disrupted the market. (2022, January 7). Bityard News
[55] [37] Nigeria internet user penetration 2026. (Statista.com)

Ukraine-Russia war and cryptocurrencies

The recent conflict further emphasized the idea that technology is neutral. Although there have been talks about how cryptocurrency could help Russia circumvent sanctions and bypass some control points (with no proof of this happening yet), we definitely saw how cryptocurrencies were able to help Ukraine fund their resistance. Moreover, cryptocurrencies are most likely able to help the citizens of both countries. Russian citizens seem to have ramped up their volume of Bitcoin trading on the initial day of the conflict (24th february 2022), spiking 270% on (₽) traded volume (on the pair USDT-RUB). Similarly the trading volume between Bitcoin and the Hryvnia (₴) increased 270% on the same day[56].

The reasons are numerous. On the Russian side, the many sanctions imposed on their banking system by the rest of the globe might make it hard or impossible for expats to send back remittances to their families. Concurrently, the value of the Ruble reached all-time lows against the US dollar. Many Russian citizens might have seen Bitcoin as a way to protect themselves against the economic fallout of the war. On the

[Fig. 6] Tweet from Mykhailo Fedorov, Twitter

Ukranians side, cryptocurrencies have been endorsed as a way to donate directly by the Ukrainians government officials. Mykhailo Fedorov was the first to tweet out the addresses just two days into the conflict[57] (Fig. 6). Through another tweet, Alex Bornyakov, Ukraine's deputy minister in the Ministry of Digital

[56] [43] Cryptocurrency a 'double-edged sword' in Ukraine-Russia war, experts (globalnews.ca)
[57] [49] Ukraine tweets its BTC, ETH addresses, raises $6 million in a day. (n.d.)

Transformation shared details of how, as of March 11 2022, they had spent nearly all $100 million in crypto received to buy military equipment, medicines, packed lunches and more[58]. Cryptocurrency may also safeguard Ukrainian citizens against a possible takeover of Ukraine's financial system by the Russian forces, since the money moved on the blockchain would not be compromised in the process.

Again we see how the decentralized nature of cryptocurrencies makes them hard to seize and censor, and how this can bring value to citizens, especially in times of conflict. Not having to rely on a centralized banking system frees up the individual on many levels. In circumstances like this one, another important attribute of crypto comes up: its high transportability. Imagine having to flee your own country for whatever reason. Personally I would not feel at ease knowing that my life savings are at the bottom of a backpack I am carrying around. But as long as I can remember or have access to my private keys, I could access my funds from anywhere in the world with ease.

Let us look at this case through the framework. Cryptocurrencies in this scenario fulfill various **needs** of both the Russian and Ukrainian population. Bitcoin is extremely transportable and secure, which makes it easy to store your money without fear of losing it or lacking control of it. Moreover, new possibilities of transacting "offline", or through HAM radio have already been proven and tested[59,60], and despite a few shortcomings, we might see further developments in this regard in the following years. For Russians as well as Ukrainians, Bitcoin fulfilled the need of a *store of value* as well, albeit for different reasons. In any case, these newfound needs sprouted and pushed further the adoption of cryptocurrencies in both countries.

On both sides of the conflict, citizens had no trouble learning and using existing platforms, softwares, and web applications available to obtain bitcoins, suggesting that the technology might have already reached a satisfactory level of **ease of use** for widespread adoption.

The approach of the **regulators** was of course favorable in Ukraine, where recently a law has passed allowing foreign and Ukrainian crypto exchanges to operate

[58] [40] Alex Bornyakov [@abornyakov] on Twitter
[59] [47] Tate, A. (2021, December 9). How to Send Bitcoin Over Ham Radio.
[60] [44] No Internet, No Problem: How to Send Bitcoin by Amateur Radio – Technology Bitcoin News

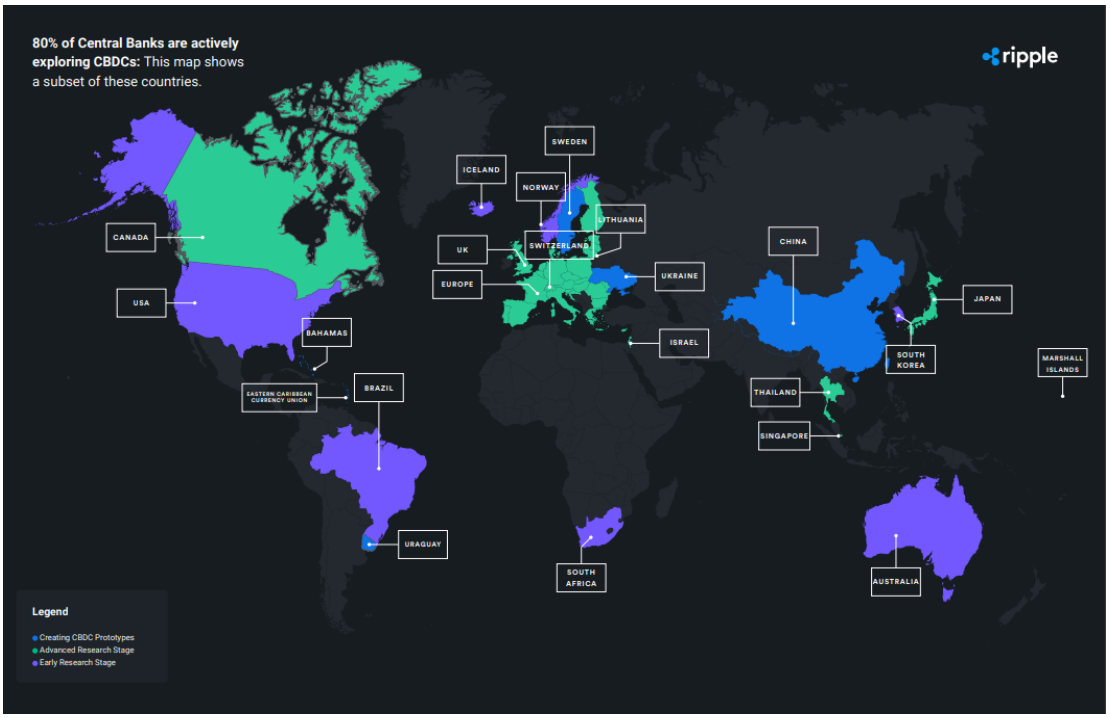
legally in the country[61]. This also means that banks will be allowed to open accounts for crypto companies, allowing for the integration of cryptocurrencies into the financial system (which as we saw in Nigeria, was fundamental to bootstrap adoption). It also allows Ukraine to start regulating the market, such as issuing licenses to crypto businesses and implementing the state policy in the industry. This will hopefully achieve a higher level of trust from the general public, while increasing the market's stability and integrity.

Again, the **facilitating conditions** may be found in the high level of digitization and digital literacy in Ukraine. Although it is not an english-speaking country, the majority of the population can understand Russian very well, meaning that they still have access to a wide array of resources. Both digital literacy and Russian speaking capabilities likely favored the fast adoption of cryptocurrencies.

[61] [48] Ukraine legalizes crypto sector as digital currency donations continue to pour in. (cnbc.com)

Central Bank Digital Currency

Most central banks around the world are currently exploring or even testing (for example, the e-Yuan pilot in China) the possibility of implementing CBDCs on a large scale[62] (Fig. 7).

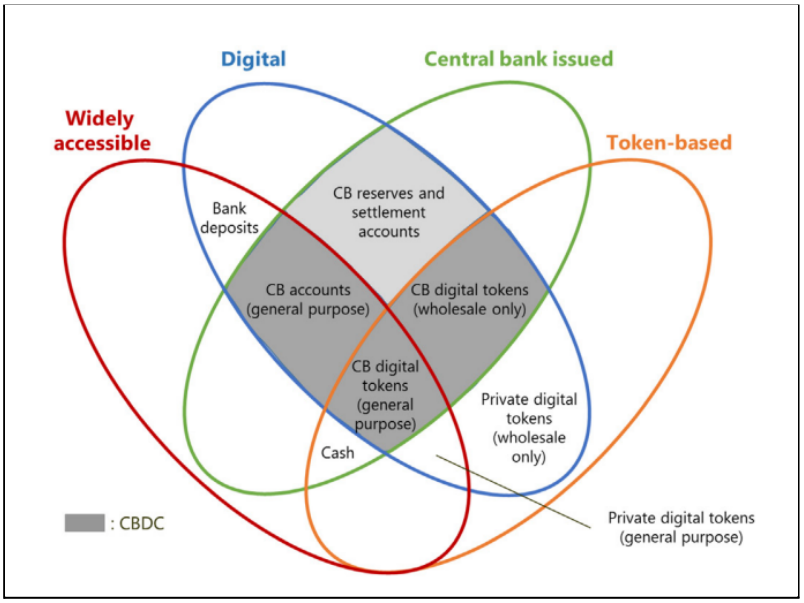


[Fig. 7] Ripple's CBDCs development map by country

The reasons are multiples, and have been outlined fairly well by the Bank of England in their 2020 discussion paper on CBDCs[63]. They identified many opportunities that CBDCs may allow for central banks to maintain their general directives of monetary and financial stability, which can be summarized in a single statement: the need for central banks not to become isolated from the financial system they support. In recent years in fact, there has been an increasing reliance on fintech and private payment services, and central banks have seen their role in the economy start to diminish[64]. This is especially clear since CBDCs are being pursued by the central banks themselves, and are not being explicitly demanded by their citizens. But what are CBDCs? Central Bank Digital Currencies are digital currencies that would be issued by the central bank of a sovereign country. Digital currencies are not exactly a new concept for central banks. The reserves that commercial banks hold at a central

[62] [101] Cbdc-whitepaper-2020 pdf. (Ripple) p. 1
[63] [53] Central Bank Digital Currency: Opportunities, challenges and design. (Bank of England)
[64] [58] Tietoevry.com. (n.d.-b). Why do central banks want digital currencies?

bank are an example of digital currency currently in use[65]. CBDCs on the other hand would presumably take on the role of the digital form of the nation's existing currency. CBDCs will probably branch into two main sectors: retail (or consumer) and wholesale[66] (Fig. 8). The first intended to be used as a payment medium and possibly legal tender, while the latter would entail a facilitator role for example for financial institutions to communicate directly with the central banks. CBDCs would allow central banks to become integrated with the private retail payment platforms, while assuming a bigger role of settlement and record of change, all this while lowering costs and allowing for instant, round-the-clock transactions.

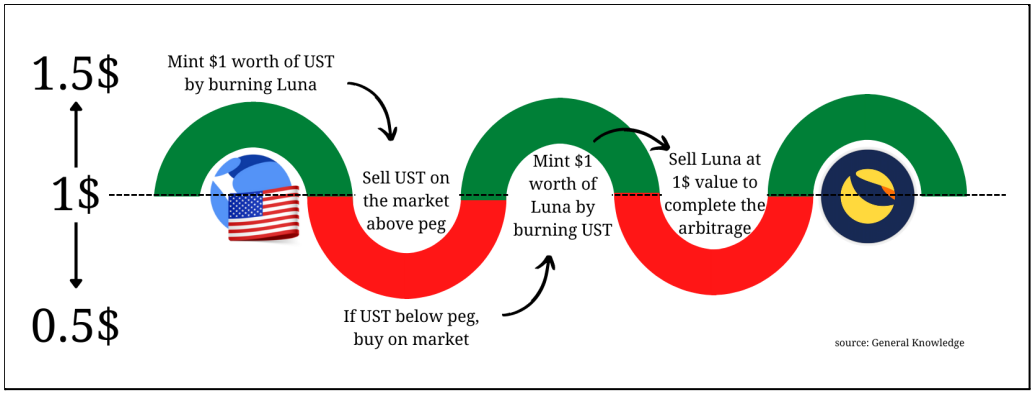


[Fig. 8] Source: The Bank of International Settlements (BIS)

But many CBDCs proposed designs have little to do with cryptocurrencies. Some may not even be based on blockchain technology (or Distributed Ledger Technology), as central banks may not see a need for a decentralized solution of this kind for their own digital currency[67]. Generally, the tendency by central banks is to see CBDCs as an evolution to cash, but not as a straight substitute. The two forms of currency would be complementary, at least initially, also as a response to the lower and lower use of banknotes that we have seen in the latest years.

[65] [52] Blog | La politica monetaria con una moneta digitale: Un'analisi di costi e benefici. (2020, November 12). Econopoly.
[66] [54] Chen, S., Goel, T., Qiu, H., & Shim, I. CBDCs in emerging market economies. p.9
[67] [53] Central Bank Digital Currency: Opportunities, challenges and design. (Bank of England), p.41

While CBDCs may not become a substitute for cryptocurrencies (as they will probably be subject to the same restrictions imposed on FIAT currencies), an interesting role they could develop is that of stablecoins. Stablecoins are digital currencies (usually cryptocurrencies) that have their value tied to existing currencies such as the US Dollar, the Euro, etc. They are usually issued on a collateral receipt (which means that each unit of stablecoin is backed by a collateral in actual currency) or are algorithmically driven (this means that an algorithm is constantly analyzing and responding to the alternating pulses of demand and supply, matching them accordingly). This is where the stability of the value of stablecoins is derived from. Some examples would be Tether (which claims that each USDT is backed 1:1 by a US$ banknote), and Carbon or Terra, which are algorithmically driven[68]. Unfortunately, very recently, on 09/05/2022, TerraUSD (UST) collapsed, its current value on 26/05/2022 hovering at $0.0876, bringing billions of dollars of losses[69]. How does a stablecoin lose its value and stability? UST was based on the Terra ecosystem, specifically, it was tied to LUNA, Terra's native cryptocurrency coin. LUNA was used to pay for transaction fees, staking, and governance proposals on the Terra blockchain. It used LUNA to power a novel mint and burn mechanisms supposed to peg the value of TerraUSD to 1 US Dollar[63]. This is how it works: on the terra blockchain, 1 dollar worth of LUNA can be "burned" (or destroyed) to "mint" (or create) 1 UST. Conversely, 1 UST can always be burned to mint 1 dollar worth of LUNA (Fig. 9).



[Fig. 9] TerraUSD-LUNA arbitrage system

[68] [56] Quirk, D. (2019, February 11). What are Stablecoins? A guide to Fiat-Pegged Cryptocurrencies. The Capital.
[69] [59] Wallet, S. (2022, May 20). TERRA, LUNA & UST Collapse: What Happened? | Step by Step Explained. General Knowledge.

This means that if 1 UST is trading at 1.5$ **above** its 1$ peg, one would be incentivized to buy 1 dollar worth of LUNA, and then burn the 1 dollar worth of LUNA to mint 1 UST (currently worth 1.5$), and then sell their new UST for another stablecoin for instant profit. The same process applies for the other case. If 1 UST is trading at 0.5$, **below** its 1$ peg, one is incentivized to buy 1 dollar worth of UST (2 UST), and then burn the 2 UST acquired to mint 2 dollars worth of LUNA, taking an instant profit if they were to immediately sell their newly acquired LUNA for something else (be it FIAT or some other crypto). This system, based on perpetual arbitrage, artificially created buy/sell pressures on LUNA and UST holders, which fixed the value of UST at 1$. The catch is that in order to realize any of these profits, the newly minted LUNA or UST must be immediately sold for some other asset. This was not a problem with a bull crypto market, but suddenly spiraled out of control as soon as a sharp decline in value appeared, and people were not as interested in speculating but rather on holding their coins. Because of many underlying reasons (seigniorage fees, the Anchor protocol, the foundation of the Luna Foundation Guard and subsequent backing of UST with BTC and and timeliness of some transactions) on the 7th of May the value of UST was pushed slightly below its 1$ peg, and given the crypto market crash that began just a few days prior, many with exposure to UST immediately sold their stakes out of safety concerns. This meant that as the value of UST continued to fall, many started to buy and burn UST to mint LUNA (which was already falling together with the rest of the crypto market). This sell pressure and increase in supply of LUNA made its value reach even lower, and when LUNA's market cap fell below UST market cap, the death spiral for both crypto began[70]. Many attempts were tried in the meanwhile to restore UST's peg, to no avail. This grand failure of an algorithmic stablecoin could be a huge reason why users could prefer CBDCs over crypto. Albeit inferior in theory to cryptocurrencies, they will be much safer, **stable**, and a legal tender nonetheless. CBDCs could take over the role of stablecoins in the crypto environment, while allowing central banks to more easily implement monetary policies and reduce friction between international payments, for cheaper. Some companies, such as Ripple Labs Inc. are working on the creation of a

[70] [59] Wallet, S. (2022, May 20). TERRA, LUNA & UST Collapse: What Happened? | Step by Step Explained. General Knowledge.

settlement system (Ripple) that could be used as the starting framework for the testing and launch of CBDCs, while ensuring global interoperability.

The idea of CBDCs was not well received among cryptocurrency enthusiasts. Many believe that the centralization of this decentralized digital currency completely defeats the purpose (especially if they will not be based on DLT) of removing a third party to verify a transaction between two individuals, which is often the reason why people want to escape FIAT currencies.

This belief is grounded on the simple notion that government and currency should remain separate to be able to efficiently operate. Many problems arise through this digitalization and centralization of cryptocurrencies. The most obvious problem will be that a record of every transaction ever done by its users will be at the fingertips of the central banks. This is not trivial, as the amount of data this entails creates huge questions on how personal privacy could be preserved. CBDCs will also likely have the ability to be programmable in some way[71], layering on top the possibility that each "coin" or citizen wallet could be taxed depending on your affiliations or spending patterns.

Although it is still too early to tell about the fate of CBDCs, they could play in the near future an important role in the cryptocurrency environment, even if they have some inherent problems. CBDCs will very likely be developed since central banks will want to retain their role as regulators of the monetary policy. But even then, monetary policies will probably look very different, since the chain made up of "central banks" ↔ "commercial banks" ↔ "families and companies" will be shortened, and companies and citizens alike could have a direct relation with their central bank[72]. Allowing anyone to open up an account at the central banks through these CBDCs would obviously create some conflicts with commercial bank's deposits. Why would anyone take on the risk of keeping their money at a commercial bank, when they could keep them, risk-free, at their central bank? The other main issue is that the intermediation role of commercial banks would become much more risky, and the lower deposits may force an economic recession[73]. So the real issue

[71] [53] Central Bank Digital Currency: Opportunities, challenges and design. (Bank of England) p.45
[72] [57] Tietoevry.com. The implications of Central Bank Digital Currencies for everyday users and banks.
[73] [52] Blog | La politica monetaria con una moneta digitale: Un'analisi di costi e benefici. (2020, November 12). Econopoly.

would be how to maintain the stability of the financial system, in case for example of an economic crisis, in which a "bank run" from commercial banks to CBCDs would be inevitable. The central banks would have to take on the role of financial intermediators themselves, with all the risks that the job implies. While a central bank "cannot" go bankrupt, eventual losses would influence their ability to control inflation[67]. The economic system as a whole would probably gain some much needed efficiency through the implementation of CBDCs, as the financial transactions within the system would be the mirror image of the economic transactions, meaning that tax avoidance would become a thing of the past. Another possibility that CBCDs could create, in a future where physical cash is no longer present, is that of negative interest rates on central bank deposits, allowing for more wiggle room to apply economic policies[67].

If we take a peek through the framework in this case, we can notice, again, that in the developed countries in which central banks are pursuing CBDCs, there is no direct **need** for them by the general population. This is because for most of them the current financial system is understood and works well enough. On the question "What would it require for you to start using bitcoin?", one of the clustered replies was "I do not know", and in particular, to the question "What you think it would require for your family and/or our circle of friends to start using bitcoin?" some replied "why should anybody use this?", denoting a clear absence of need for such a technology in developed countries[74]. This is likely what is stopping widespread adoption from the users side. Although seeing the relevance of the technology, central banks and governments are rightly pursuing the possibility of CBDCs.

Being mostly in development, the **ease of use** of CBDCs is difficult to pinpoint, but the huge tests that China is undergoing with the e-Yuan (e-CNY), with up to 261 million individual digital wallets set up at the end of last year[75], implies that it is easily combined and usable alongside the current legacy banking system, further boosting its adoption for widespread use.

The **regulator's approach** is clear in this case, since CBDCs are being pursued directly by the regulators. This suggests that in the near future, we may see a

[74] [20] Presthus, W., & O'Malley, N. O. (2017). Motivations and Barriers for End-User Adoption of Bitcoin as Digital Currency
[75] [86] 张文芳. (n.d.). Zhejiang may drive fresh e-CNY trials, global.chinadaily.com.cn

more involved approach to cryptocurrencies by the regulatory authorities, since there is a clear interest in the technology.

The **facilitating conditions** are all in favor for developed countries, which have access to a wide array of resources and possibilities. Broad research is being conducted on the technology and implications of cryptocurrencies as we speak. Although we cannot predict the future, all the cues point in the direction of adoption in the near future (the European Union is currently investigating the possibility of creating the Digital Euro, which will be decided in October 2023[76]).

[76] [103] Bank, E. C. (2022, March 31). Digital euro. European Central Bank.

El Salvador

In El Salvador, Bitcoin is not seen the same way as the rest of the world. In El Salvador, Bitcoin **is** money. On the 7th of September 2021, El Salvador became the first country in the world to accept Bitcoin as legal tender[77,78]. Before this, the official currency of El Salvador was the colón, which was then replaced by the US dollar on January 1st 2001, in an attempt to achieve financial stability and encourage foreign investment, with scarce results[79]. Remittances also account for a big chunk of El Salvador GDP (23% of total GDP in 2020[80]), and are managed by money transmitters, since as many as 70% of citizens do not possess a bank account[81].

The first appearance of Bitcoin in El Salvador was in 2019, when an anonymous donor donated $100'000 worth of bitcoins to El Zonte, a coastal village, with the clause that the village would have to adopt bitcoin as their medium of exchange[82]. The village has now become known as "Bitcoin Beach". The village also received their first Bitcoin ATM, while still lacking a regular cash ATM, in the beginning of 2020[83]. The adoption of Bitcoin was driven mainly to ease the process of remittances by allowing digital transactions to be more accessible to underbanked people, while also lowering the costs of these transactions. The Bitcoin Law was voted on the 9th of June, 2021, and passed with a large majority of 62/84 deputies in favor[72]. A fund of $203 millions was also set aside to support the implementation of Bitcoin[84]. $150 millions to guarantee the exchange between Bitcoin and dollars, $23,3 millions to finance the project itself and the remaining $30 millions to carry out a 30$ bonus for every citizen that downloaded the government sponsored Chivo wallet app. The adoption of Bitcoin as legal tender was not without its problems. Many protested the use of tax money to purchase the cryptocurrency[85], and as many as two third of Salvadorans were against the new Bitcoin law[86]. Many also believed that the volatility

[77] [77] Renteria, N., Wilson, T., & Strohecker, K. (2021, June 10). In a world first, El Salvador makes bitcoin legal tender. Reuters.
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[84] [62] AFP. (n.d.). 8 claves para entender el uso del Bitcoin en El Salvador. El Economista.
[85] [65] Barber, G. (n.d.). In El Salvador, Bitcoin's Libertarian Streak Meets an Autocratic Regime. Wired.
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of Bitcoin would introduce more unnecessary risks to El Salvador's economy. Although El Salvador actions have also spurred other countries, such as Panama, into entertaining the possibility of Bitcoin as legal tender[87].

Recently, at the end of 2021, some plans for a "Bitcoin city[88]" were revealed by Bukele (El Salvador's president). The government would use geothermal energy provided by the Conchagua volcano to supply electricity and support their Bitcoin mining operation. They also began the drafts for "Volcano Bonds", to support the building of the city and buy yet more bitcoins.

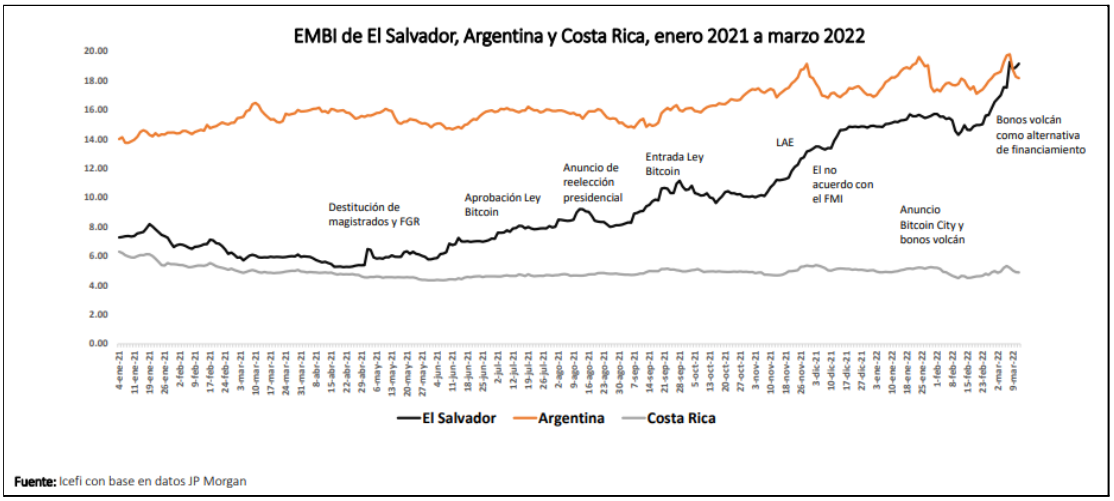
Vitalik Buterin (Founder and developer of Ethereum) also commented on reddit "Shame on everyone who are uncritically praising him [Bukele][89]". He was outspoken about the risks and recklessness of the implementation without education on the matter, as well as the hypocrisy of forcing a specific coin on the population, which is against the ideals of freedom of cryptocurrencies in general.

Many problems surrounded the implementation of Bitcoin in the months following its new status as legal tender[90]. The Chivo app, sponsored by the government, was initially not available for download on any of the standard application stores, and also encountered some server issues. They also experienced a huge problem of identity theft, in which many citizens found themselves out of the 30$ BTC bonus, as it had already been redeemed by someone else. Another major issue was the poor penetration of the internet in general in El Salvador, which meant that, in 2020, as low as 45% connectivity was achieved in the country as a whole, and in rural areas as few as 1 in 10 people had internet access[91]. Moreover, 40% of all downloads happened in september 2021, and virtually no downloads for the app have taken place in 2022[92]. The main reason for the downloads remains the 30$ bonus offered. Many that did not download the app simply did not trust the system or Bitcoin itself. As of February 2022, only 1.6% of remittances went through digital wallets, and there is no evidence of Bitcoin being used to pay for taxes[93]. Acceptance is also relatively low, as only 20% of firms report accepting bitcoins as a means of

[87] [68] Dossett, J. (n.d.). Panama unveils bill to make Bitcoin legal tender. CNET.
[88] [81] Six months in, El Salvador's bitcoin gamble is crumbling. (2022, March 15). Rest of World.
[89] [84] Vitalik Buterin comments on El Salvador.
[90] [76] Most Salvadorans have already ditched their national bitcoin wallets. (2022, May 4). Rest of World.
[91] [67]Digital in El Salvador: All the Statistics You Need in 2021. (n.d.). DataReportal – Global Digital Insights.
[92] [105] National Bureau of Economic Research. (n.d.). Retrieved May 28, 2022, p.2
[93] [76] Most Salvadorans have already ditched their national bitcoin wallets. (2022, May 4). Rest of World.

payment[94]. El Salvador national reserve also registered a loss of around $22 million by January 2022, as the price of bitcoin fell 45% from its all time high.

This makes it clear that the status of legal tender bestowed to Bitcoin is not enough to make it a general medium of exchange in the population, especially without the correct infrastructure and education on the subject.



[Fig. 11] ICEFI rendering of JP Morgan data on their Emerging Market Bond Index

Although Bitcoin did have (at least in the short term) some positive effects on the economy of El Salvador (Fig. 11), it has yet to achieve the desired effect of being the preferred currency among its citizens, and many of the problems the country had before the implementation of Bitcoin as legal tender, still remain.

So what does the framework tell us about what went wrong in El Salvador? First, there is a clear **need** in El Salvador for a better financial system. The country is currently completely dependent on the US dollar and money transmitters for remittances, and since most people do not have a bank account, Bitcoin or crypto in general could take over that role. Unfortunately a **need** being present in a country and being perceived by the population. A pool done by the Centro de Estudios Ciudadanos, from the Universidad Francisco Gavidia in El Salvador, found that up to 91% of El Salvadorans prefer the US dollar, and in a pool done the July prior, as many as 53,5% considered the decision of rendering Bitcoin legal tender unacceptable.

The **ease of use** for Bitcoin has been vastly supported by the El Salvadoran government, through their many initiatives: providing over 1500 Bitcoin/Dollar ATM

[94] [105] National Bureau of Economic Research. (n.d.). Retrieved May 28, 2022, p.2

kiosks, creating a BTC fund to guarantee that the exchange between dollars and BTC by Salvadorians was always available, deploying and incentivizing the use of the government sponsored wallet Chivo, made to be particularly user friendly.

The **regulator's approach** in the case of El Salvador is clear-cut. They wanted to harness and use the power of Bitcoin to revamp their economy and rightly pursued this road. Unfortunately, they did not consider that adoption does not happen simply because it is imposed on someone. This further reinforces the idea that although technology can be pursued by the regulators, pushing it onto its citizens without a clear goal or objective, and especially without a campaign supporting it. An approach similar to that of the STOP AIDS Program[95], especially for the diffusion of education and knowledge on Bitcoin and cryptocurrencies, previous to the legalization of Bitcoin as legal tender, would have probably better prepared the population to such a leap, while increasing Bitcoin's acceptance among the population.

El Salvador has few, if any **facilitating conditions**. The low english proficiency of the population[96], and low internet penetration rate, which was standing at 50,5% as of January 2021[97], means that the digital literacy and availability of resources for Salvadorians to learn about crypto and Bitcoin is not as good as it could be. The low level of internet penetration also means that a vast part of the population does not have access to crypto whatsoever, further reducing the possibility of adoption by the general public.

[95] [21] Rogers, E. M., Singhal, A., & Quinlan, M. M. (2019). Diffusion of Innovations, p.423
[96] [106] Countries That Are Most And Least Proficient In English. WorldAtlas
[97] [67] Digital in El Salvador: All the Statistics You Need in 2021. (n.d.). DataReportal – Global Digital Insights.

Conclusions and suggestions

Cryptocurrencies: money with rules, but no rulers. They have the ability to radically change the banking and financial system as we know it. They are being adopted by both governments, banks, and individuals, while slowly revolutionizing our world. Through the analysis in this thesis, I developed and applied a framework for the adoption of cryptocurrencies as a medium of exchange. Of course, what I derived from each use case is also defined by cultural and historical circumstances each country carries with them. We can be sure of one thing: technology is neutral, and policies and regulations can greatly affect how it is perceived, accepted, and deployed within a population. Bitcoin and cryptocurrencies in general are also very different (like any new disruptive technology) and can hardly be regulated by looking at laws of the past, and are in need of new laws and definitions[98]. They are also essentially impossible to shutdown, given the decentralized properties of the network they operate on. This is why I believe that cryptocurrencies should be allowed to integrate into our current financial system. Not only that, but its development should be fostered and welcomed, as many fintech and startup solutions were and are bringing some useful developments in the world through crypto. Of course there is still a need for consumer protection and market integrity, and allowing cryptocurrencies to be integrated into our current system will create a chance to also regulate the exchanges they are traded on.

The most important cause for adoption derived from the perceived **need** for the technology. As long as people need what crypto brings to the table, they will use them. But as we saw in El Salvador, it cannot be pushed onto them. They should be encouraged to research and learn about (**facilitating conditions**) to further increase the personal trust they have towards the technology, and ease adoption of it. Allowing crypto to be **integrated** into our current financial system should also be a clear priority, as the case in Nigeria might suggest the willingness of the masses to embrace cryptocurrencies, especially if they are allowed to fit in the existing financial system. Citizens of developed countries might have a higher need for greater clarity and certainty when it comes to crypto regulation.

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